

Math Intervention "SMART" Project (Student Mathematical Analysis and Reasoning with Technology)

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Introduction

For years in the field of education, technology was foreign in the regular education classroom. Technology was considered a separate subject taught in isolation, far removed from the standard curriculum. As computer technology worked its way into the classroom environment, teachers tended to use the computer for drill-and-skill practice. The high-dollar "worksheet" was not used during instruction, but as a center-based activity, greatly undermining the potential of this valuable teaching tool.

The purpose of this project was to successfully integrate SMART Board technology into classroom instruction. The teachers conducting this study felt that a new philosophy was needed. No longer was technology to be used by students once a week in a computer lab. The students needed hands-on access to the technology every day. The teachers in this study did not teach computer skills, but used the computer to teach their curriculum standards. Finally, technology in the classroom began to be utilized to maximize student learning and became a part of instruction.

This seamless integration of technology and curriculum was made possible because of SMART Board technology. The SMART Board created a venue for whole-class instruction. No longer were students crowded around a small 15" monitor; instruction was now possible from the front of the classroom. Students were able to clearly see from their seats the computer display predominantly projected on the SMART Board. This allowed teachers to take entire classes exploring on the World Wide Web. Students now had access to full multimedia presentations including animation and sound. Students' interest levels soared compared to the traditional method of instruction using the overhead and chalkboard.

The SMART Board was also very hands-on and interactive with the students. Kinesthetic learners benefited greatly by being able to come up and touch the SMART Board. The tactile response helped students make a learning connection. Touching and manipulating the SMART Board in this highly stimulating environment were key components for increasing students' understanding of teaching standards.

School Background

Mueller Elementary School has educated a diverse population of students since 1952. It is located in Wichita, Kansas, northwest of Wichita State University in a predominately African-American neighborhood. We are one of two desegregation schools for the district that helps integrate students from across Wichita into our school to meet federal integration mandates. Many of our students qualify for the federal free breakfast/lunch program. Our neighborhood preschool program has a 90% minority enrollment. As such, many of our students don't have computers or access to technology in their homes but must rely on what we have at Mueller to help them get ready for the future technological jobs in Wichita. According to *The Future of Children: Children and Computer Technology*, technology needs to equalize access to low-income students, as well as higher-income students, by providing opportunities to use computers in creative and enriching ways ("Executive Summary"). Because of our successful T.E.C STAR program, our volunteer return rate was 80% last year and 90% this year. This demonstrates parent and community support for Mueller and the technology it provides for its students.

Mueller Elementary has made great progress in using technology to support classroom learning. We have created the T.E.C. STAR (Teaching Every Child Science/Spanish, Technology, Arts/Academics, and Reading/Writing/Arithmetic) program (<http://mueller.usd259.org>). This has allowed us to focus on meeting our Campus Improvement Plan's educational objectives but to do so through a comprehensive learning process.

Math Instruction

Our school is committed to improving our test scores in math through intervention programs that will increase student achievement. Based on Gardener's Multiple Intelligence Theory, we understand that not every student learns the same way. Some students are visual learners, others are auditory learners, but the majority require tactile representation in order to understand a mathematical concept.

Math is a major focal point for our School Improvement Plan. The Wichita Public School District requires benchmark testing in the area of mathematics for second and fifth grade students to ensure learning of national and local mathematics standards. The math benchmark assessment measures each student's knowledge and understanding of math content and his/her ability to apply that knowledge. The test covers six math content areas, including numeration/estimation, geometry, patterns/relationships/algebra, probability/statistics, measurement, and computation. The test also measures each student's ability to use math processes such as problem solving, communication, and connections. These scores are added together to make an overall math score. The Wichita Board of Education set passing scores for both the second and fifth grades. Meeting these standards indicates a student has demonstrated mastery of math skills in those grades. Students not passing the math benchmarks in second and fifth grades are given additional assistance in developing better math skills. The Wichita Public Schools provide these students with interventions such as additional one-on-one interaction, summer school, and after-school tutoring.

Thirty percent of our students did not meet the benchmark requirements in second and fifth grade in the 1999-2000 school year. Because of this drop in math scores, Mueller was placed on the District's Math Watch Program. The district required interventions and strategies to increase the math benchmark scores for the next year. In order to achieve this goal, all grade levels worked together to create and use strategies that enhanced student learning in the area of math.

Mueller Elementary teachers discovered the SMART Board through an inservice at another school district. Through researching on the Internet, teachers came across Project Get SMARTer and applied for the SMART Board. Students who interacted through its touch-sensitive screen came to learn math concepts with ease. Through the use of the SMART Board, a highly motivated interactive atmosphere was established in the classroom. According to *The Future of Children*, the "use of technology that incorporates visual and collaborative teaching practices has helped promote learning among students of all ability levels" ("Executive Summary"). By incorporating technology with learning in the classroom, students' motivation increases, which brings about higher academic achievement.

Teacher Training

To begin this project, the teachers involved needed to see SMART Board technology in action. The Maize School District currently utilizes two SMART Boards for daily instruction with students. Times were set up so that two Mueller teachers could watch the Maize teachers using the Board as part of instruction and talk to the Maize teachers.

Watching the Maize teachers was very beneficial. The Maize teachers had mastered the art of using the SMART Board's interactive capability. They demonstrated the classroom management style needed for whole and small group instruction. Students were highly motivated and very interested in the lesson being taught.

After observing how the Maize teachers used the SMART Board, Mueller teachers invited our Wichita State University Mentors to come out to the school and show the technical side of the SMART Board. The WSU Mentors were able to show Mueller teachers the full range of uses for the SMART Board and its limitations. This mentor was assigned specifically to Ms. Moore's class to advise and give technical support through weekly scheduled meetings.

Participants

Ms. Moore's first grade class was made up of six girls and fourteen boys. Fifty percent of students in this classroom received free or reduced lunches. Minority students made up 55% of the class. This diverse group of learners came in with unsure ideas and attitudes toward math skills as well as the language of mathematics. Initial pretests were given to determine each student's prior knowledge. The average student correctly answered 8 out of 60 addition problems and 9 out of 60 subtraction questions. Students' scores in the area of problem solving were rated from the Wichita School district's rubric rating of 1-4. A score of one indicates basic or low performance in the majority of standards and indicators within the subject area or 60-69%. A score of four denotes advanced performance in some of the standards and indicators within this subject area or 90-100%. The class average in the area of communication was 1, reasoning 2, and problem solving 2. With the information gleaned from test scores and some consideration of environmental factors, the teacher was given the awesome task of improving these scores by any means necessary.

Strategies

To introduce the students to the SMART Board, the teacher conducted a mini workshop as to how the Board worked. Students were allowed to orient the Board through certain touch points. The teacher discussed do's and don'ts and the importance of safety and caution when walking around the multimedia projector. Students and teacher were then ready for the fun stuff!

The first lesson covered the district standard of measurement as it pertains to time:

- The student identifies time to the hour and half-hour.
- The student identifies elapse of time in increments of one hour.

The "Executive Summary" for *The Future of Children: Children and Computer Technology* states, "Computer technology has been demonstrated to enhance classroom instruction by making learning more engaging, and by providing new ways of teaching complex concepts and critical thinking." Using SMART Notebook, the teacher utilized various frames to discuss the parts of the standard clock. Students were able to draw the parts of a clock step by step on the SMART Board. Information was retained and made relevant when creating a construction-paper model clock the following day.

During a whole class lesson, students enjoyed telling time with the online Snapdragon (<http://www.bbc.co.uk/wales/snapdragon/yesflash/time-1.htm>). Students would simply touch arrows to set the time on a standard clock. The SMART Board was perfect for this lesson because of its sensitivity to touch and the ability to write directly on the Board to give directions or clues, or for performance assessment. For example, the teacher would ask a student to color the minute hand blue and the hour hand red. Feedback was immediately available to the students from the Web site.

The next standard addressed covered measurement as it pertained to the area of money:

- The student will identify value of coins up to half dollar
- The student will find value of coin combinations to 50¢

Counting money has always been a difficult concept to grasp for first graders. Using the SMART Board was an excellent aid for the teacher as well as the students. The district no longer purchases workbooks that correlate with the teacher's math manual. Ms. Moore transposed a colored page in her manual directly to the SMART Board screen. Students identified coins by writing the word penny, nickel or dime beside the actual picture using a different color for each coin. Counting money became fun during center time when using the SMART Board. Each student had his/her own punch-out coins to display how much was needed to buy various items offered on a Spending Spree (www.primarygames.com). Individually, students would take turns finding the answer. If needed, students would add up coins using the Board's pens to aid in processing information. To increase difficulty, students could keep a running total in their journals for each item purchased and how much was spent.

Utilizing the KID PIX software, students mastered the district standard addressing computation:

- The student joins and separates sets to 18
- The student shows addition and subtraction are inverse operations

Student A used the pen tool to write a math problem on the screen (for example $7 + 9$). Student B showed the answer. Student C utilized the moving van tool to highlight one of the addends and manually rearrange the order. Students discovered that regardless of the order ($9 + 7$ or $7 + 9$) the answer was unchanged. This was a strategy that students used when given timed tests in addition.

During each lesson there was increased time on task. Students were eager to answer questions and patiently waited their turn. Frequently the question was asked, "Will we use the SMART Board today in math?" Memorizing math facts was made fun and inviting when using flashcard races via the SMART Board. When teaching the four-step problem-solving model, students enjoyed moving from frame to frame discussing how they arrived at their answer.

Outcomes

When evaluating the SMART Board's effectiveness, we compared Ms. Moore's experimental group to another first grade classroom at Mueller that was comparable to Ms. Moore's student population. Ms. Moore's students excelled in the areas of mathematics where the SMART Board was used for instruction. On the 4-point problem-solving rubric, Ms. Moore's class began the year scoring an average of 2.1. At the end of the year, the same students averaged a score of 3.5. It was dramatic for a class to show a growth of 1.4 points in one year. The controlled group only showed 0.9 growth on this same test.

At the beginning of the year, 32% of Ms. Moore's class correctly answered the pretest coin value question and 27% correctly answered the pretest coin combination question. After working with the SMART Board on money value and combinations, 95% of the students scored a correct answer for coin value on the posttest and 75% of the students correctly answered the coin combination posttest question. The control group scored 76% on the coin value posttest and 41% on the coin combination posttest.

The same results were evident for teaching the standard of time and knowledge of basic addition and subtraction math facts. Beginning of the year pretests showed that only 14% of the class could correctly identify time in half-hour intervals. By the end of the year, 100% of Mrs. Moore's class mastered this standard whereas the control group scored 82%. Basic math fact scores showed tremendous growth. Students entering the classroom for the first time could only correctly answer 12.8% of their addition and subtraction facts. At the end of the year, 71.5% of the math facts were correctly answered. By the end of the year, 85.7% of the addition facts were mastered, with nine students scoring 100%. This was a growth of 58.7%.

Student Survey

Students in Ms. Moore's classroom were given a survey at the beginning and end of the study to poll their attitudes regarding math and their comfort level towards technology. Eighteen of the twenty students were more comfortable using pencil and paper compared to the use of technology. Only eight of the twenty students were somewhat comfortable using a computerized mouse. At the end of the study, 100% of the participants preferred using the SMART Board and other forms of technology as opposed to traditional paper and pencil methods of instruction.

Conclusion

Did the SMART Board aid in producing smarter kids? Based upon the significant growth, academic achievement, and positive attitudes toward the specific skills taught, the answer appears to be yes. The SMART Board used as a tool, in combination with effective teaching strategy, brought about dramatic results. The level of enthusiasm in Ms. Moore's math class is far above that of a typical first grade classroom. Not only did the level of interest among students heighten; Ms. Moore was challenged to think and teach in a new way. This teacher shared the enthusiasm of her students and thought of various ways to promote interaction, stimulate discussion, and make learning easy and enjoyable in the process.

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